

Claims

[c1] 1. A magnetic device comprising:

a layer of ferromagnetic material;

a layer of antiferromagnetic material interfacially exchange coupled with the ferromagnetic layer, whereby the ferromagnetic layer exhibits perpendicular exchange bias.

[c2]

2. The device according to claim 1 [Claim Reference] wherein the antiferromagnetic material is selected from the group consisting of a cobalt oxide, a nickel oxide, an oxide of an alloy of cobalt and nickel, and a platinum-manganese alloy.

[c3]

3. The device according to claim 1 [Claim Reference] wherein the layer of ferromagnetic material has in-plane magnetic anisotropy, and wherein the layer of antiferromagnetic material is interfacially exchange coupled with the ferromagnetic layer at the edges of the ferromagnetic layer, whereby the ferromagnetic layer exhibits perpendicular exchange bias at said edges.

[c4]

4. The device according to claim 1 [Claim Reference] wherein the layer of ferromagnetic material has perpendicular magnetic anisotropy.

[c5]

5. The device according to claim 4 [Claim Reference] wherein the ferromagnetic material having perpendicular magnetic anisotropy is selected from the group consisting of a cobalt-platinum-chromium alloy, an iron-platinum alloy, one or more cobalt-platinum bilayers, and one or more cobalt-palladium bilayers.

[c6]

6. The device according to claim 5 [Claim Reference] where the cobalt-platinum-chromium alloy includes one or more of B, Nb and Ta.

[c7]

7. The device according to claim 5 [Claim Reference] wherein any one of the cobalt layers in said bilayers includes one or more of the elements selected from the group consisting of B, Ta, Cr, O, Cu and Ag.

[c8]

8. The device according to claim 1 [Claim Reference] wherein the device is a magnetic recording medium.

[c9]

9. The device according to claim 8[Claim Reference] further comprising a substrate, an underlayer on the substrate, and a capping layer, and wherein the exchange-coupled ferromagnetic layer and antiferromagnetic layer are located between the underlayer and the capping layer.

[c10]

10. The device according to claim 1[Claim Reference] wherein the device is a magnetic tunnel junction read head.

[c11]

11. The device according to claim 10[Claim Reference] wherein the ferromagnetic layer is the sensing ferromagnetic layer of the magnetic tunnel junction and has two side edges, and wherein the antiferromagnetic layer comprises two portions, each portion being in contact with a respective side edge of the ferromagnetic layer.

[c12]

12. The device according to claim 1[Claim Reference] wherein the device is a magnetic tunnel junction memory cell having an insulating tunnel barrier layer.

[c13]

13. The device according to claim 12[Claim Reference] wherein the ferromagnetic layer has its magnetic moment pinned in a direction perpendicular to the barrier layer of the magnetic tunnel junction by being perpendicularly exchange biased by the antiferromagnetic layer.

[c14]

14. A magnetic device comprising:

a substrate; and

a bilayer of a ferromagnetic layer and an antiferromagnetic layer on the substrate, the ferromagnetic layer having perpendicular magnetic anisotropy with its magnetic moment oriented generally perpendicular to the plane of the ferromagnetic layer and being perpendicularly biased by the antiferromagnetic layer.

[c15]

15. The device according to claim 14[Claim Reference] wherein the material of the antiferromagnetic layer is selected from the group consisting of a cobalt oxide, a nickel oxide, an oxide of an alloy of cobalt and nickel, and a platinum-manganese alloy.

[c16]

16. The device according to claim 14[Claim Reference] wherein the material of the ferromagnetic layer is selected from the group consisting of a cobalt-platinum-chromium alloy, an iron-platinum alloy, one or more cobalt-platinum bilayers, and one or more cobalt-palladium bilayers.

[c17]

17. The device according to claim 14[Claim Reference] wherein the device is a perpendicular magnetic recording disk and further comprising an underlayer located between the substrate and the bilayer, and wherein the antiferromagnetic layer is a layer of nickel-oxide directly on the underlayer.

[c18]

18. The device according to claim 14[Claim Reference] wherein the ferromagnetic layer comprises a cobalt-platinum-chromium alloy directly on the antiferromagnetic layer.

[c19]

19. The device according to claim 14[Claim Reference] wherein the device is a magnetic tunnel junction memory cell having a pinned ferromagnetic layer, a free ferromagnetic layer and an insulating tunnel barrier layer between the pinned and free layers, wherein the material of the antiferromagnetic layer is a platinum-manganese (PtMn) alloy, and wherein the ferromagnetic layer is the pinned layer with its magnetic moment pinned in a direction perpendicular to the tunnel barrier layer by being perpendicularly exchange biased by the PtMn alloy antiferromagnetic layer.